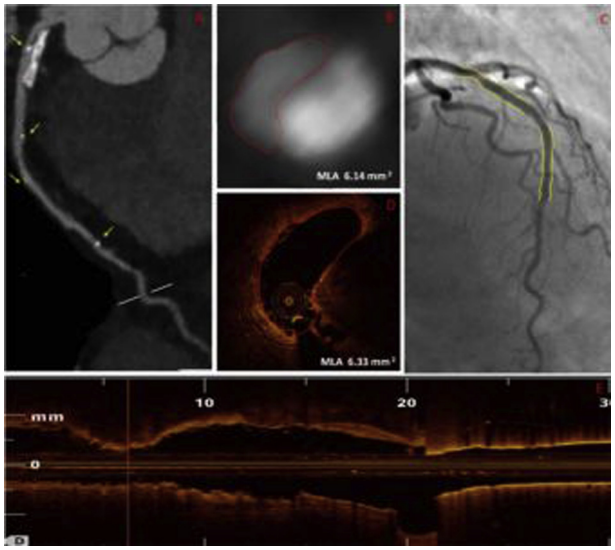


## TCT-305

### Quantification of Coronary Artery and Myocardial Deformation Due to Cardiac Motion using Cardiac-gated Computed Tomography Data

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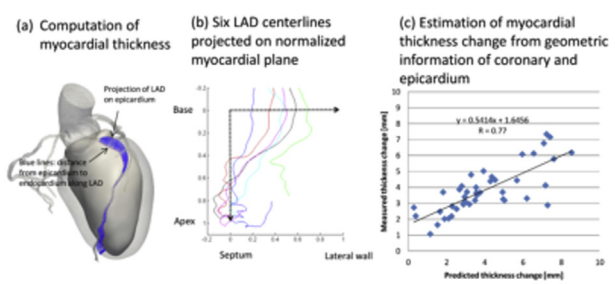
**Background:** Knowledge of cardiac contractility is crucial for functional assessment of myocardial dysfunction. Since coronary arteries conform to the myocardium, quantification of coronary deformation may be useful for assessing myocardial function. The purpose of this study was to develop methods to estimate myocardial contractility with coronary artery deformation.
**Methods:** Epicardium and endocardium surfaces, and the left anterior descending coronary arteries (LAD) of 6 patients were extracted from cardiac-gated computed tomography data using level set segmentation methods. Between systole and diastole, curvature changes of the LAD centerlines were quantified, as well as myocardium thickness changes by computing distances between the epicardium and endocardium surfaces along the LAD. Support Vector Machine (SVM) learning algorithm was utilized to estimate the myocardial deformation from other geometric features of the coronary artery.
**Results:** From diastole to systole, coronary curvature values increased by 0.040±0.063 mm-1 and myocardial thickness increased by 3.9±2.2 mm. Using metrics of curvature, curvature changes, and distance of the coronary to the epicardial surface, heart base, and ventricular septum, the SVM algorithm resulted in a correlation of R=0.77 of prediction to local myocardial thickness change for all 43 bend points along the 6 LADs.




**Conclusions:** The SVM algorithm shows that myocardial contractility is strongly correlated to geometric information of the coronary arteries and epicardium. These methods may provide a new framework to evaluate myocardial function from coronary artery deformations.

## TCT-306

### Pulse Wave Velocity and Augmentation Index are predictors of the Coronary Atherosclerosis and Impaired Cerebrovascular Reactivity.

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**Background:** Pulse wave velocity (Pwv) and augmentation index (Aix) are well known predictors of cardiovascular and cerebrovascular morbidity and mortality. The aim of our work was to analyze correlation between those two parameters of arterial wall stiffness, coronary atherosclerosis and cerebrovascular reactivity, which is the marker of subclinical cerebrovascular disease.
**Methods:** 187 patients, referred for elective coronarography, were randomised to the study. All of them were examined by a cardiologist and underwent selective coronarography, transcranial doppler ultrasound with estimation the cerebrovascular reactivity (using breath-hold-index BHI) and assessment of arterial stiffness using the Arteriograph TensioMed device. Gensini score and number of significant lesions (more than 50%) were used for evaluation of the coronary atherosclerosis. Data were analysed with Mann-Whitney U-test, Spearman correlation, Kruskal – Wallis test and ROC analysis. Significance level was $p < 0,05$.
**Results:** Differences in Pwv and Aix between groupe SCG 0 and groupes SCG 1-3 were statistically significant (p=0,015 resp. p< 0,001). Significant was also the correlation between Pwv, Aix and Gensini score. Spearman correlation coefficient was 0,6 (p< 0,05) for Aix and 0,43 (p< 0,05) for Pwv. ROC analysis of Aix >5,3% had 86% sensitivity and 75% specificity in prediction of coronary atherosclerosis. Pwv > 10,5% had 76% sensitivity and 66% specificity. Significant correlation of Aix and Pwv with BHI was proven by linear regression. Spearman correlation coefficient was Aix 0,6 (p< 0,05) and 0,42 (p< 0,05).
**Conclusions:** There is a significant correlation between values of pulse wave velocity, augmentation index, presence of coronary atherosclerosis and impaired cerebrovascular reactivity.

## TCT-307

### Intracycle CT Motion Correction Algorithm in the evaluation of Coronary artery disease

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**Background:** The purpose of this study is to demonstrate that coronary CT angiography (CCTA) employing a novel intracycle motion compensation algorithm (SnapShot Freeze [SSF]) will be superior to CCTA without intracycle motion compensation algorithm (conventional CCTA) for image quality and diagnostic accuracy.
**Methods:** Forty patients with known or suspected coronary artery disease were studied with CCTA and invasive coronary angiography (ICA). CCTA scans were performed on a 128-slice CT scanner (Discovery CT 750HD, GE Medical Systems) using prospective or retrospective ECG-gating depending on the patients' heart rate. In the prospective ECG mode, padding of 100 ms was used, while in the retrospective ECG mode, cardiac X-ray current was ECG-triggered between 40% to 75% of the R-R interval. First, SSF-CCTA scans were analyzed; 2 weeks later in a random and blinded way the conventional-CCTA scans were evaluated. The per-vessel and per-segment diagnostic interpretability and image quality of SSF CCTA and conventional CCTA was calculated. A 17-coronary artery anatomy model classification was used for the analysis. Dichotomization of the five-point Likert scale was performed by grouping scores 1 and 2 into the "non-diagnostic" category and scores of 3, 4 and 5 into the "diagnostic" category. The paired Student t-test was used to determine the diagnostic differences between CCTA scans. $P < 0.05$ was referred to statistically significant.
**Results:** From the 40 patients studied, 584 coronary segments were analyzed. SSF-CCTA had 5 coronary segments non-evaluable whereas conventional CCTA had 33 coronary segments. The coronary segment assessability was 99% vs 94% respectively. There was statistical difference between SSF-CCTA and conventional-CCTA for all coronary arteries (p: 0.0002 for RCA; p: 0.0416 for LAD; p: 0.0135 for LCX. Global p value for all coronary arteries was $< 0.0001$. Conventional-CCTA had an average coronary segment analysis of 3.1 versus 3.8 of the SSF-CCTA.
**Conclusions:** SSF-CCTA allowed better visualization of the coronary arteries especially of the RCA. SSF-CCTA also reduced the number of non evaluable coronary segments in comparison to conventional-CCTA.

## TCT-308

### Prevalence and Distribution of Obstructive Pelvic Arterial Lesions by Computed Tomographic Angiography in 261 Patients with Erectile Dysfunction: Endovascular Therapeutic Implications

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**Background:** Pelvic arterial insufficiency is widely present in patients with erectile dysfunction. In this study, we would like to confirm our previous observations

regarding the prevalence and distribution of obstructive pelvic arterial lesions by using the multi-detector computed tomographic (CT) angiography in a much greater number of patients with erectile dysfunction.
**Methods:** This study included 261 consecutive patients (mean age 61.0 years) with erectile dysfunction. Pelvic angiograms of the arterial system supplying the penis were divided into 5 segments: common iliac artery, internal iliac artery, anterior division, internal pudendal artery, and penile artery. Obstructive arterial lesion was defined by a luminal stenosis of ≥50% on CT.
**Results:** Among the 2,610 segments obtained, only 28 segments (1.1%) of penile arteries were identified as non-analyzable. 189 patients (189/261, 72%) had at least one obstructive lesion in their pelvic CT angiograms. A total of 432 obstructive segmental lesions were identified (average 2.3 lesions/patient). The distribution of these obstructive pelvic arterial lesions was: 2 (0.5%) in common iliac artery segment, 26 (6.0%) in internal iliac artery segment, 34 (7.9%) in anterior division segment, 169 (39%) in internal pudendal artery segment, and 201 (47%) in penile artery segment. The obstructive lesions were limited in penile artery segments in 63 patients (63/189, 33%), whereas only 22 patients (22/189, 12%) with obstructive lesions limited in the internal pudendal artery segments. 88 patients (47%) had accessory penile blood supply, of which 4 obstructive lesions were found.
**Conclusions:** We confirmed that obstructive pelvic arterial lesions were present in over 70% of patients with erectile dysfunction and most lesions were in the penile artery segment. A higher percentage of patients (~50%) had accessory arterial supply to the distal penile arteries. These findings reinforce the importance of pelvic CT angiography as a comprehensive diagnostic tool and the inclusion of penile artery segment as the essential target for endovascular therapies for patients with erectile dysfunction and inadequate response to phosphodiesterase-5 inhibitors.

## FFR and Physiologic Lesion Assessment

***Washington Convention Center, Lower Level, Hall A***

**Saturday, September 13, 2014, 5:00 PM–7:00 PM**

Abstract nos: 309-343

### TCT-309

**Influence of subtended myocardial mass on intracoronary physiology indices of stenosis severity and microcirculatory function.**

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**Background:** Fractional flow reserve (FFR), coronary flow reserve (CFR) and index of microcirculatory resistance (IMR) are growingly used to interrogate the epicardial and microcirculatory domains of the coronary circulation. Since coronary flow is determined by the size of the perfused vascular bed, the amount of myocardial mass (MM) subtending to the site of measurement may influence their relationships; and most importantly, the assessment of stenosis severity and microcirculatory disease. We aimed to evaluate how MM influence FFR, CFR and IMR.
**Methods:** FFR, CFR and IMR were measured in 123 coronaries (102 patients) with intermediate stenosis. Jeopardized MM was estimated with validated angiographic scores including the Myocardial Jeopardy Index (MJI).
**Results:** Whilst CFR was not statistically correlated with MM [MJI: ρ=-0.103, (95% CI: -0.275 to 0.065), p=0.257)], a significant inverse relationship was noted between MM and FFR [MJI: ρ=-0.338, (95% CI: -0.486 to -0.171), p< 0.001)] and IMR [MJI: ρ=-0.408, (95% CI: -0.546 to -0.249), p< 0.001)]. FFR≤0.80 vessels jeopardized higher MM than FFR>0.80 vessels [MJI: 21.3% (Q1-3, 16.7-26.5%) vs 16.7% (Q1-3, 13.0-21.7%), p< 0.001] and; contrarily, IMR ≥30 U vessels jeopardized lower MM than IMR< 30 vessels [MJI: 13.0% (Q1-3, 12.5-18.2%) vs 20.4% (Q1-3, 15.10-25.5%), p< 0.001]. MM differed between agreement groups of the FFR/CFR relationship (p for overall comparison=0.009), and vessels with FFR≤0.80 and CFR>2 presented the largest subtended MM.
**Conclusions:** The amount of myocardium subtended to a coronary stenosis 1) modulates FFR and IMR 2) does not have an influence on CFR; and 3) plays an important role in the FFR/CFR discordance.

### TCT-310

**Recanalization Of Chronic Total Coronary Occlusions, The Influence On Collateral Donor Artery Physiology & Fractional Flow Reserve**

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**Background:** There is evidence of an outcome benefit supporting the use of Fractional Flow Reserve (FFR) to guide multi-vessel coronary revascularization. The presence of a concomitant chronic total coronary occlusion (CTO) and a large collateral contribution might alter the FFR of the interrogated vessel, making the FFR unreliable. This would be expected to reverse on recanalization of the CTO, such that best treatment strategy could change. We sought investigate the change in donor vessel FFR associated with PCI of a concomitant CTO.
**Methods:** 44 patients undergoing angioplasty to a CTO were included in the study. Distal and proximal coronary pressure and flow velocity were measured using a dual sensor tipped coronary guide-wire (ComboWire, Volcano Corporation, San Diego, California) at rest and adenosine induced hyperaemia in distal and proximal segments of both non-target vessels before and after angioplasty. Haemodynamics including FFR, absolute coronary flow and the coronary flow velocity-pressure gradient relation were calculated off-line. The predominant donor vessel was selected blinded to haemodynamic measurements based upon angiography.
**Results:** 32 of 44 cases were successful. Following successful recanalisation of the CTO, mean increase in predominant donor vessel FFR was 0.783 to 0.813, mean difference: 0.029(0.013-0.046, p=0.001). Mean decrease in resting donor vessel absolute flow, adjusted for rate-pressure product: 169.8ml/min to 138.6ml/min (mean difference -31.1(-54.3 to -7.9, p=0.01), mean decrease in hyperaemic flow: 295.8ml/min to 263.2ml/min (mean difference -32.6(-59.1 to -6.1, p=0.018). Change in predominant donor vessel FFR correlated with angiographic (%) diameter stenosis severity (r=0.42, p=0.015) and was strongly related to stenosis severity measured by the coronary flow velocity-pressure gradient relation (r=0.67, p< 0.001).
**Conclusions:** Recanalization of a CTO results in a modest increase in the FFR of the collateral donor vessel associated with a reduction in coronary flow. A larger increase in FFR is associated with greater coronary stenosis severity. The expected change should be considered when planning multi-vessel revascularization in this setting.

### TCT-311

**Pressure Wire Pullback Using the Instantaneous Wave-Free Ratio (iFR) Can Identify Stenoses and Predict the Improvement After Stenting**

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*[1]Imperial College London, London, London, [2]Imperial College London, London, United Kingdom, [3]Imperial College, London, United Kingdom, [4]Hospital Clinico San Carlos, Madrid, Spain, [5]Hospital Universitario Clinico San Carlos, Madrid, Spain, [6]IMPERIAL COLLEGE NHS TRUST, London, London, [7]National Heart Centre Singapore, London, United Kingdom, [8]Imperial College NHS Trust, London, London, [9]Imperial College Healthcare Trust, London, United Kingdom, [10]Imperial College Healthcare NHS Trust, London, United Kingdom*

**Background:** The instantaneous wave-free ratio (iFR) is a resting index that can be measured during a controlled pressure-wire pullback to calculate the intensity of pressure drop (ΔiFR/mm) and the physiological length of lesions (Figure 1). Using computer-aided virtual PCI, we sought to determine whether removing stenoses on the iFR-Pullback could predict the hemodynamic impact of stenting diffuse and/or tandem disease.